

RIGHT FLIGHT

Objectives

The students will:
Construct a flying model glider.
Determine weight and balance of a glider.

Standards and Skills

Science

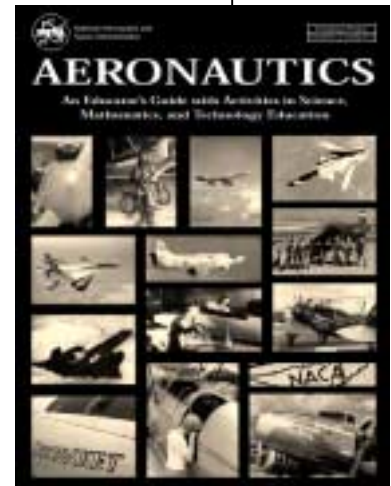
Science as Inquiry
Physical Science
Science and Technology
Unifying Concepts and Processes

Science Process Skills

Observing
Measuring
Collecting Data
Inferring
Predicting
Making Models
Controlling Variables

Mathematics

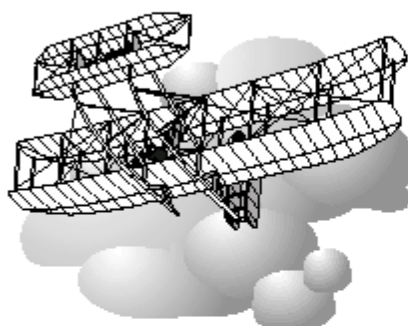
Problem Solving
Reasoning
Prediction
Measurement



Background

On December 17, 1903, two brothers, Wilbur and Orville Wright, became the first humans to fly a controllable, powered airplane. To unravel the mysteries of flight, the Wright brothers built and experimented extensively with model gliders. *Glider*s are airplanes without motors or a power source.

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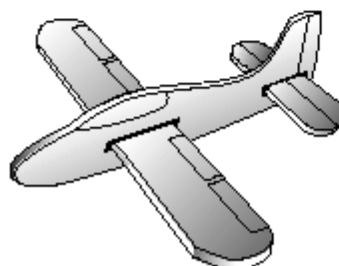
Wright Flyer

Building and flying model gliders helped the Wright brothers learn and understand the importance of *weight* and *balance* in airplanes. If the weight of the airplane is not positioned properly, the airplane will not fly. For example, too much weight in the front (nose) will cause the airplane to dive toward the ground. The precise balance of a model glider can be determined by varying the location of small weights.

Wilbur and Orville also learned that the design of an airplane was very important. Experimenting with models of different designs showed that airplanes fly best when the *wings*, *fuselage*, and *tail* are designed and balanced to interact with each other.

The Wright Flyer was the first airplane to complete a controlled takeoff and landing. To manage flight direction, airplanes use control surfaces. *Elevators* are control surfaces that make the nose of the airplane *pitch* up and down. A *rudder* is used to move the nose left and right. The Wright Flyer used a technique called *wing warping* to begin a turn. On modern airplanes, *ailerons* are used to *roll* the airplane into a turn.

At NASA, model airplanes are used to develop new concepts, create new designs, and test ideas in aviation. Some models fly in the air using remote control, while others are tested in wind tunnels. Information learned from models is an important part of NASA's aeronautical research programs. The goals of NASA research are to make airplanes fly safer, perform better, and become more efficient.



Right Flight Glider

This activity is designed to help students learn about basic aircraft design and to explore the effects of weight and balance on the flight characteristics of a model glider. Students use science process skills to construct and fly the Styrofoam glider.

Materials

Styrofoam food tray, size 12
Glider template
Plastic knife
Toothpicks
Sand paper or emery board
Binder clips
Paper clip
Markers
Goggles (eye protection)

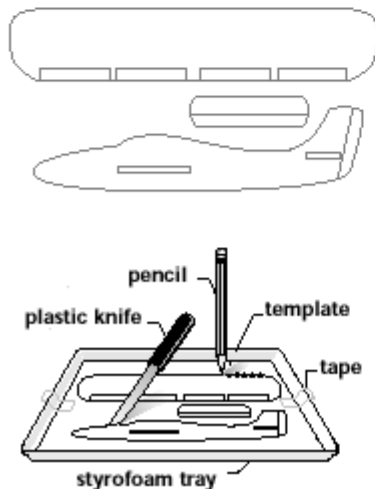
Part 1

Building the Glider

Preparation

1. Ask students to name some materials that might be used to build a model glider. *Responses might include balsa wood, paper, cardboard, plastic, and Styrofoam.*
2. Gently toss a Styrofoam tray into the air and ask the students to describe how the tray "flew." *The tray does not fly because it is not designed to fly. Instead of flying (gliding) it drops.*
3. Explain to students that Styrofoam is lightweight and strong which makes it an ideal material to construct model gliders. Styrofoam trays can be obtained from the meat department of a grocery store.

Activity



1. Hand out the materials (Student Page 1, tray, template, cutting and marking devices). Follow the steps listed on the Student Page.

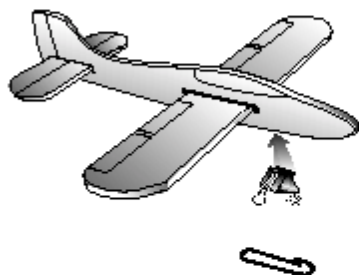
2. Explain that the template is a guide to cut the wings, fuselage, and elevator from the Styrofoam. Cutting can be done in a variety of ways depending on grade level.

For younger students, the teacher or older students can cut out the parts beforehand and have the students assemble the glider. For older students, the teacher can demonstrate cutting out the parts using a serrated plastic knife.

Another way to cut out the parts is by punching a series of holes approximately 2 mm apart around the outside edge of each piece and then pushing the piece out. A sharp pencil or round toothpicks can be used to punch the holes.

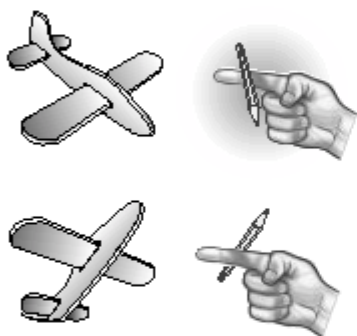
Part 2

Caution students not to throw gliders toward other students. The teacher may want to provide eye protection for each student.



1. The model glider's weight must be balanced or distributed properly before it will fly. To demonstrate this, ask a student to launch a glider before adding weight and balance. Have students describe the flight characteristics.
2. Add weight to the model using paper clips, binder clips, or a penny. Attach the paper clip or penny to the nose of the glider. If a binder clip is used, attach it to the bottom of the fuselage. Ask the students to test fly the glider and observe the flight characteristics.
3. Move the weight (clips) forward or backward on the fuselage to determine the best weight and balance for the glider. The best weight and balance combination can be defined as one that allows the glider to fly the greatest distance.

Discussion



Aircraft weight is balanced as a pencil is on your finger.

1. Is weight and balance important on "real" airplanes? Yes, *all airplanes are required to have correct weight and balance. The pilot is responsible for making sure the total weight of the cargo and passengers is within certain limits and is distributed to keep the plane properly balanced. Flights should not be attempted if the aircraft is overloaded, or if the cargo distribution makes the plane too "nose heavy" or "tail heavy."*
2. Why does the model glider fall erratically during test flights before its proper weight and balance is determined? *Lift is a force generated by the wing. This force must be in balance with the weight distribution of the airplane before the model will fly successfully.*

Assessment

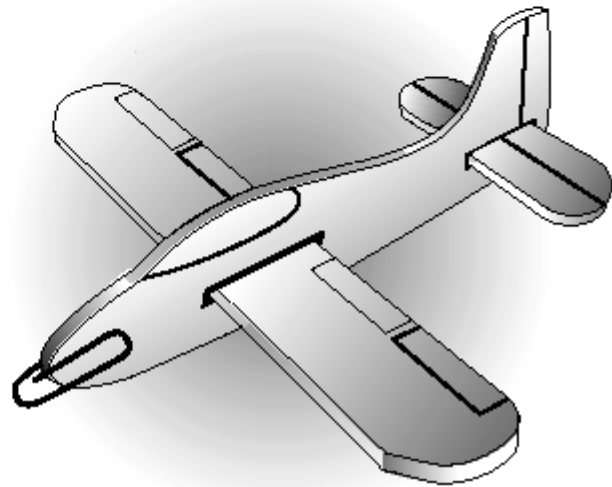
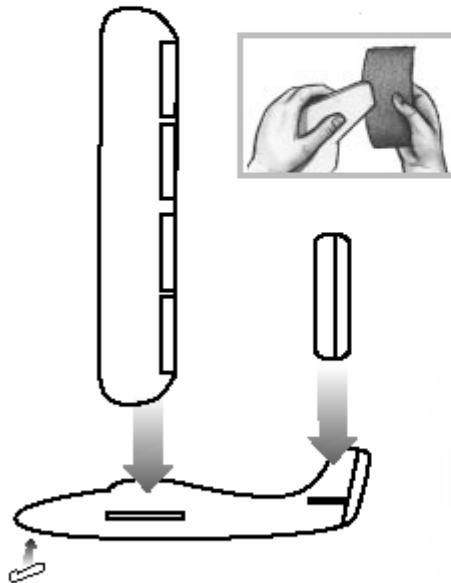
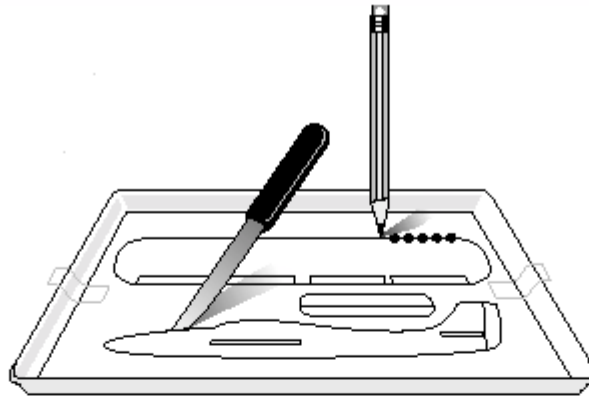
1. Students will successfully meet one objective of the activity by constructing the model glider.
2. Using the model glider, have students explain how they determined the weight and balance for their glider.

Extensions

1. Set up a flight course and have the students demonstrate the flight characteristics of their gliders.
2. Have students cut 2 cm off of each wing tip, and begin a new series of flight tests.
3. Have students design and make new wings for the glider. Experiment with wings of various sizes and shapes.



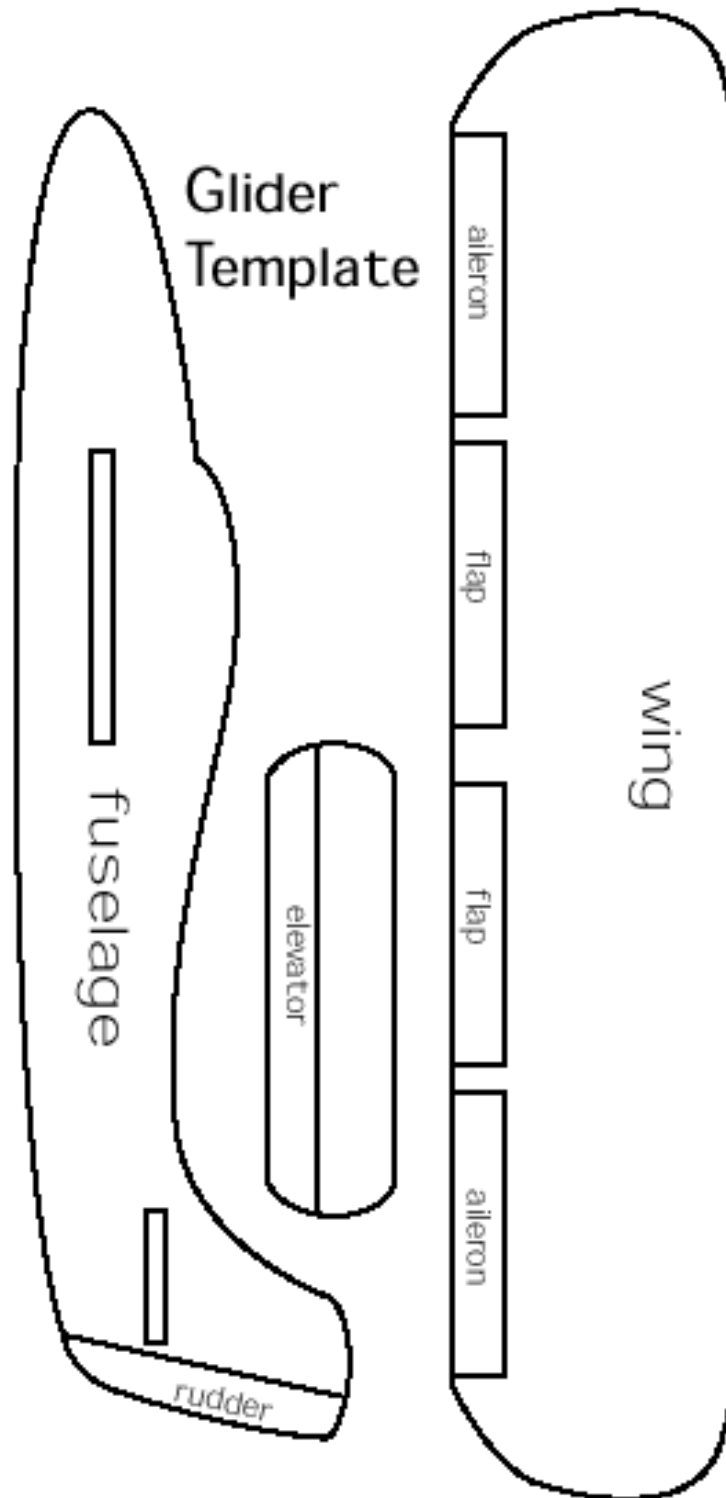
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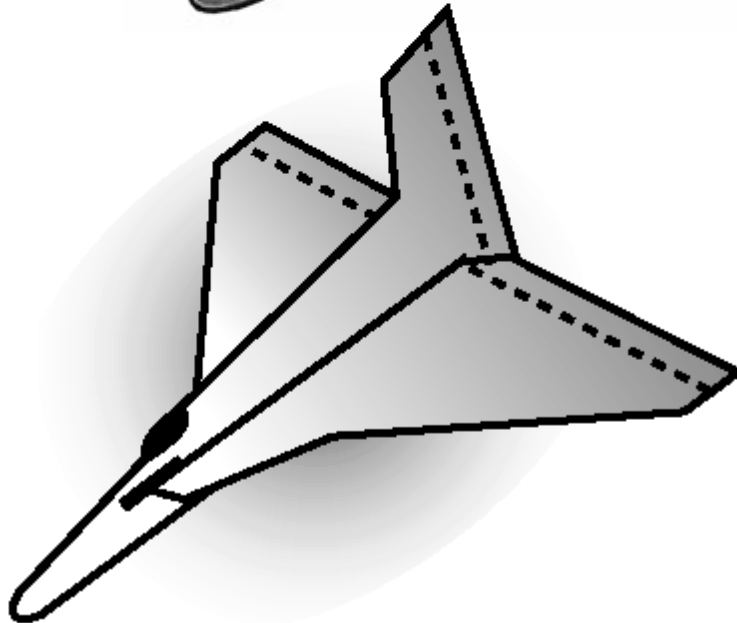
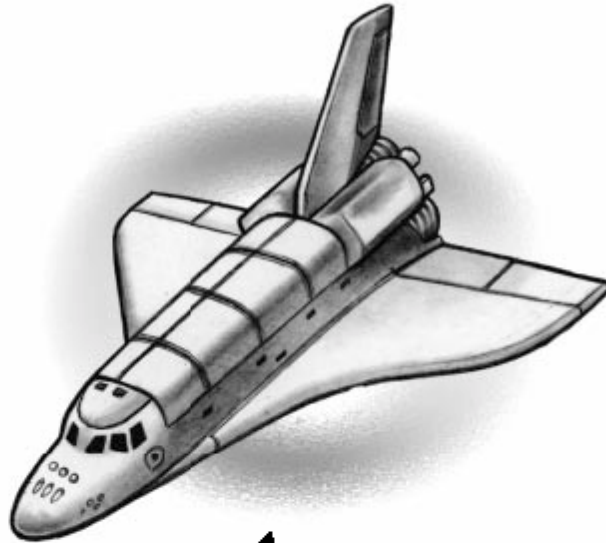
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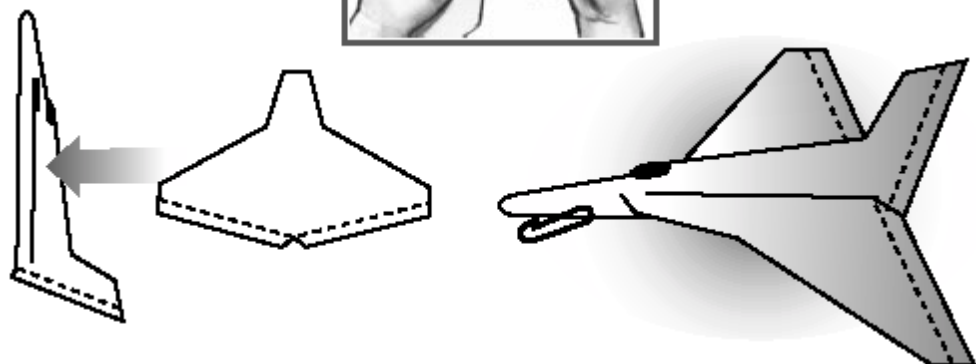
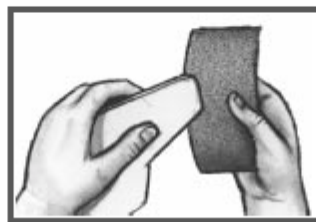
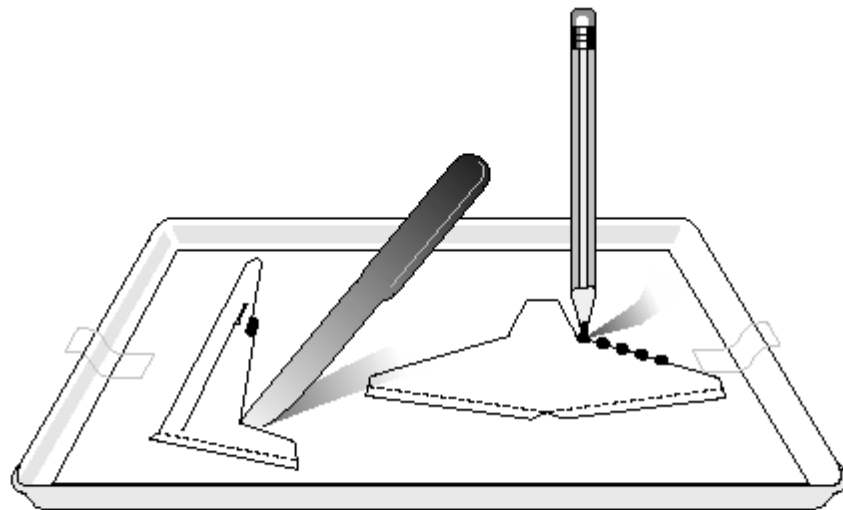
Delta Wing Glider



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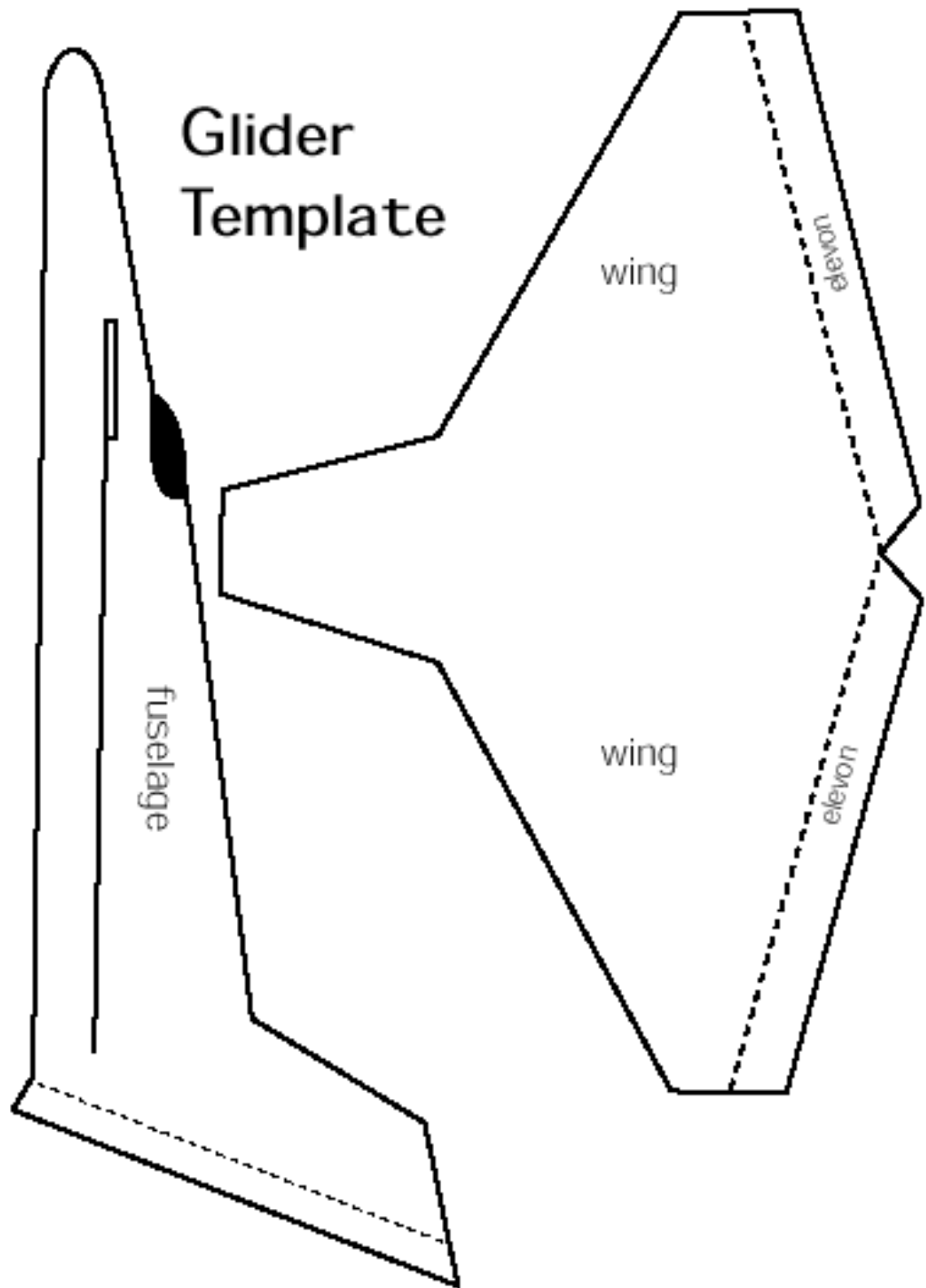
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Delta Wing Glider



Test Question: Does changing the position of the elevons on a delta wing glider change its flight path?

Directions: Bend the elevons into the positions listed below. Be sure to predict the flight path before flying the glider. Test fly the glider and record the results (up, down, left, right).

Student Test Pilot Record Sheet (What I Observed)

Position of elevons		Predicted Flight Path	Path of Test Flight
Right and left straight		_____	_____
Right and left up		_____	_____
Right and left down		_____	_____
Right down, left up		_____	_____
Right up, left down		_____	_____

Does moving the elevons change the way the glider flies?

What happens when both elevons are in the up position?

What happens when both elevons are in the down position?

Does changing the position of elevons on a delta wing glider change its flight path?

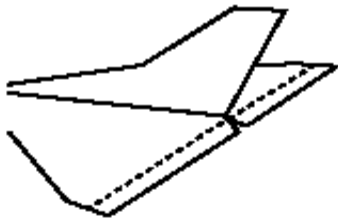
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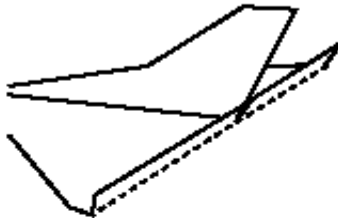


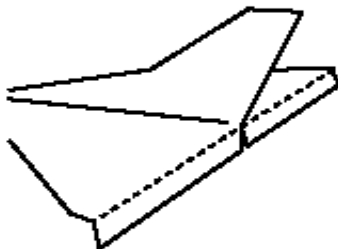
Delta Wing Glider

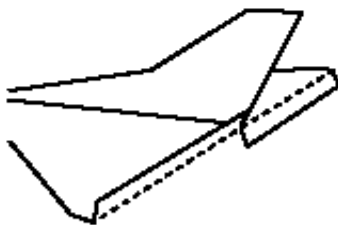


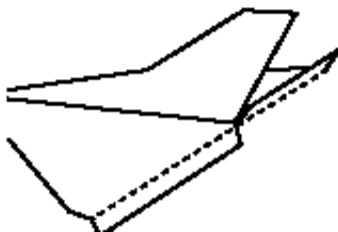
Draw the flight path











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